

## **MEDICAL HISTOLOGY AND EMBRYOLOGY**

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### **Educational Objectives**

This course intends to provide students of Medicine and Surgery scientific understanding of the morphological cytology, whole histology and embryology. In addition principles and techniques of Tissue Engineering and regenerative Medicine will be defined.

The primary aim of the course is to provide students with an understanding and knowledge of cell and tissue general morphology and histophysiology; an understanding of the main mechanisms of differentiation and development of the human body.

Students are expected to have an understanding of the following:

- main methods in morphological investigation;
- cell structure and ultrastructure;
- tissues organization (structure and histophysiology);
- differentiation and growth processes;
- human body development and clinical correlates (embryology).

Students should be capable of :

1. recognizing different tissues and specific structure from images or under the microscope
2. relate the morphology with function and basic physiology and links to pathophysiology
3. describe the development of different systems and organs and their main molecular mechanisms;
4. principal malformations and defects affecting morphology and functions.

### **9. Text books**

Ross-Pawlina: Histology VI edition, Lippincott

T W Sadler: Langman's Medical Embryology, Lippincott

Schoenwolf, Bleyl: Larsen's Human Embryology, V edition, Elsevier

Moore, KL: The Developing Human, Clinically Oriented Embryology, 9<sup>th</sup> edition, Elsevier.

## **Core curriculum**

### **HISTOLOGY**

Adhesion molecules (CAM). Stem cells and differentiation. Polarization. For each tissue is required a general knowledge and the specific organisations: cell types, extracellular matrix and its components, histogenesis, histodifferentiation, regeneration possibility.

Epithelium: classification. Surface specializations. Specialized junctional structures and cytoskeleton.

Exocrine and endocrine glands.

Sensorial epithelia. Particularly differentiated epithelia.

Connective tissue: matrix, fibers and cells of the connective tissue. Types of connective tissue.

Mucous, reticular, elastic, pigmented, adipous connectives.

Cartilage.

Bone tissue. Histogenesis, bone remodeling and repair.

Blood. Endothelium. Hemopoiesis. Bone marrow. Immune system. Lymphoid organs: thymus, lymph nodes, spleen.

Smooth, cardiac and skeletal muscle.

Nervous tissue: Synapses. Structure of periferic nerves.

### **EMBRYOLOGY**

Reproduction and evolution. The dynamism of living organisms.

Male and female gonades. Gametogenesis. Fertilization. Segmentation. Cleavage. Decidua.

First week of development

Second week of development.

Formation of the extra-embryonic structure.

Gastrulation.

Embryonic layers and their fate.

Neurulation. Notochord, somites.

Organogenesis:

Musculoskeletal, upper and lower limbs, hearth and blood vessels, urogenital, digestive and related glands, respiratory, head and neck including thyroid and tongue, nervous system.

Placenta. Twins.

Induction phenomena. Malformation and defect associated with all systems mentioned.

Major genes involved in development, induction and differentiation.

### **Preliminary knowledge**

Basic knowledge of the biology of the cell.

Formal lectures:

### **Hystology**

**Epithelial Tissue:** Overview of epithelial structure and function, classification of epithelium, the apical domain and its specialization, the basal domain and its specialization.

**Glands:** overview of glands structure and function, glands classification, exocrine glands, endocrine glands: pancreas, pituitary gland, thyroid, parathyroid, adrenal glands, pineal gland, interstitial glands.

**Connective Tissue:** overview of connective tissue, embryonic connective tissue, connective tissue proper, connective tissue fibers structure and formation.

**Cartilage:** overview of cartilage, hyaline cartilage, elastic cartilage, fibrocartilage, chondrogenesis and cartilage growth and repair.

**Bone:** overview of the bone, general structure, types of bone tissues, cells of the bone, bone formation (endochondral and intramembranous ossification), mineralization process, bone repair.

**Blood:** overview of the blood, plasma, erythrocytes, leukocytes, thrombocytes, complete blood count, formation of blood cells (hematopoiesis), bone marrow.

**Muscle tissue:** overview and classification of muscle tissue, skeletal muscle, cardiac muscle, smooth muscle, structure of the sarcomere, contraction in the smooth muscle, functional consideration.

**Lymphatic system:** overview of lymphatic system, cells of the lymphatic system, lymphatic tissue and organs.

**Nerve tissue:** overview of nervous system, composition of nervous tissue, the neuron, the supporting cells (neuroglia), organization of central and peripheral nervous system.

### **General embryology**

**Introduction to embryology:** general consideration on development, glossary, how to approach the topic.

**Gametogenesis:** primordial germ cells, morphological changes during gametes maturation, oogenesis, spermatogenesis, menstrual cycle (effect on ovary, uterus, hormones, corpus luteum).

**First week of development: from ovulation to implantation:** changes to the sperms in the female reproductive system fertilization, cleavage blastocyst formation, initiating implantation.

**Second week of development:** full implantation, formation of syncytiotrophoblast and its function, hCG, formation of amniotic cavity, formation of the chorionic cavity and yolk sac, formation of bilaminar disc, uteroplacental circulatory system.

**Third week of development:** gastrulation, formation of the notochord, establishment of body axes, neural plate formation. Clinical Correlates: Holoprosencephaly, situs inversus, caudal regression syndrome.

**Forth week of development:** Embryo folding, neurulation, neural crests, somite differentiation.

**Development of placenta:** fetal membranes and placenta, structure of placenta, chorion frondosum and decidua basalis. Clinical correlate: preeclampsia, placenta previa.

## **Organogenesis**

**Musculoskeletal system:** differentiation and origin of musculoskeletal system, Somites differentiation into sclerotome and dermomyotome development of skull, vertebrae and vertebral column, limbs development. Clinical Correlates: craniosynostosis, cranioschisis, spina bifida, scoliosis: limbs malformations: meromelia, amelia, syndactyly, polydactyly.

**Development of the Heart:** formation of the primary heart tube, cardiac looping, formation of septa, formation of aorticopulmonary septum, fetal circulation and change at birth, development of vasculature. Clinical Correlates: atrial septal defect, ventricular septal defect, tetralogy of fallot, transposition of great arteries, patent ductus arteriosus.

**Development of gastrointestinal tract:** formation of gut tube, role of endoderm and lateral mesoderm. nomenclature: visceral and parietal peritoneum, mesentery, peritoneal organs, primarily and secondarily retroperitoneal organs. Formation of foregut, stomach formation and rotation, formation of lesser and greater omentum, formation of liver, pancreas, spleen, development of midgut and rotations, physiological hernia, development of hindgut, portal circulation. Clinical Correlates: Annular pancreas, omphalocele, gastroschisis, umbilical hernia, Meckel diverticulum, vitelline cists and fistula.

**Development of urogenital system:** the intermediate mesoderm, formation of pronephros and mesonephros, formation of definitive kidneys, mesonephric and paramesonephric ducts, formation of urinary bladder and urethra, the trigone. Development of gonadal ridges, germ cells migration, formation of testis and ovaries. Development of female reproductive tract: fallopian tubes, uterus and vagina. Development of male reproductive tract: epididymis, vas deferent, ejaculatory duct, seminal

vesicle, and prostate. Formation of the external genitalia. Clinical correlates: renal agenesis and dysplasia, polycystic kidney, oligohydroamnios and Potter sequence, horseshoe kidney, pelvic kidney accessory renal arteries, ureters malformations, bladder defect, urachal cist and fistula, uterus defects, cryptorchidism, hypospadias.

**Developments of pharyngeal apparatus and face:** pharyngeal arches, pouches and clefts, development of splancoctanium, mandible and maxilla, development of face, nasal and oral cavities, development of tongue, thyroid, parathyroid and thymus, cranial nerves associates with arches, neural crests. Clinical Correlates: di George Syndrome, Facial clefts, brachial fistulas, ankyloglossia, mascroglossia, thyroglossal cyst and fistula.

**Development of nervous system:** structural and functional division of nervous system. Primary and secondary brain vesicle, differentiation of neural tube. Development of spinal cord, development of brain. Neural Crest. Clinical Correlates: anencephaly, exencephaly, hydrocephalus, Hirschsprung disease.